this work he also prepared a report on the Tertiary Lignite Formation, a memoir on the 'Superficial Deposits of the Central Region of North America,' and papers on the 'Locust Visitations,' on the 'Fresh Water Sponges of Canada' and on the 'Fluctuations of the American Lakes.'

When the work of the Boundary Survey was brought to a close, he was appointed, in 1875, to the Staff of the Geological Survey of Canada, and, in 1883, on the retirement of Dr. Selwyn, he succeeded him as Director of the Survey, which position he held at the time of his decease. His field work, while connected with the Geological Survey, was carried on chiefly in British Columbia and the Northwest Territories, and the excellent character of this work contributed largely to the great development of the mining industry in these parts of the Dominion in recent years.

Dr. Dawson also rendered important public service in connection with the Behring Sea arbitration. As one of the British Commissioners he spent the summer of 1892 in the Behring Sea region, for the purpose of inquiring into the facts and conditions of seal life. The report of the Commission constituted the case of Her Majesty's Government, and I remember hearing at the time a high tribute paid to Dr. Dawson's ability by one of the gentlemen connected with the United States side of the case, in the statement that had it not been for Dr. Dawson's evidence and arguments, a finding much more favorable to the United States would probably have been secured. In connection with his services on this arbitration he was made a Companion of the Order of St. Michael and St. George (C. M. G.).

He usually enjoyed excellent health and had great capacity for hard work, but he succumbed very suddenly, on the 2d of March last, to an attack of acute bronchitis after an illness of but two days.

Dr. Dawson was a prolific writer. In addition to his numerous and voluminous official reports, he contributed many papers on geological, geographical and ethnological subjects to the scientific magazines and to the Transactions of various learned societies, both on this continent and in England.

He received the degree of D.Sc. from Princeton, and the degree of LL.D. from Queen's University in 1890 and from McGill University in 1891. In the same year he received the Bigsby gold medal from the Geological Society of London for his services to the science of geology, and was elected a Fellow of the Royal Society. In 1893 he was elected President of the Royal Society of Canada. In 1896 he was President of the Geological Section of the British Association for the Advancement of Science at its Toronto meeting, and was last year President of the Geological Society of America. His presidential address, delivered on retiring from the latter position, appeared in a recent number of SCIENCE. In 1897 he was awarded the gold medal of the Royal Geographical Society. He also received many other distinctions which cannot here be mentioned.

Dr. Dawson was a man of more versatile gifts than his father, but like him possessed of an unusual combination of scientific insight, literary ability and administrative capacity. He was a man of broad views, clear and judicial frame of mind, modest and retiring, but withal an excellent conversationalist. He won the esteem of all who knew him, and his loss will be keenly felt by his very large circle of friends.

FRANK D. ADAMS.
MCGILL UNIVERSITY, MONTREAL.

*STATE NATURAL HISTORY SURVEYS.**

A GEOLOGICAL survey of Wisconsin, very complete and careful for the time, was com-

* Abstracts of addresses made before the Naturalists, meeting in Chicago, December, 1900.

pleted in the year 1878. During the following twenty years no investigations of this character were carried on in the State. In 1897, however, the Legislature organized the present Geological and Natural History Survey and gave to it for the first two years an appropriation of $5,000 annually, which was doubled during the second biennial period. The government of the Survey is in a Board of Commissioners, consisting of the governor of the State, the president of the State University, the State superintendent of Public Instruction, the president of the Commission of Fisheries, and the president of the Wisconsin Academy of Sciences, Arts and Letters. The director of the survey from the first has been E. A. Birge, professor of zoology in the University of Wisconsin. The work of the Survey has been done along three lines: economic, scientific and educational.

The first piece of work of economic importance was the investigation of the building stones of the State, to which two years were devoted by Dr. E. R. Buckley, who is in charge of this department, and, as a result, a full report on the building stones was published as a bulletin of the Survey in 1899. After the completion of this work, Dr. Buckley turned his attention to the clays and the clay industries, on which he is still engaged. A general report on this subject will appear during the present winter, and the work will be continued probably for at least a year or two in the future. The geological structure of the Keweenawan, or copper-bearing rocks, of Douglas and adjacent counties of northern Wisconsin has been worked out by Professor U. S. Grant, and a preliminary report has been published.

Of the several scientific investigations, the most important is the geology of the crystalline rocks in the central part of the State—a region which was almost entirely uninhabited at the time of the earlier survey. Its investigation has been assigned to Dr. S. Weidman, who has been carrying on field work since the organization of the Survey and who will prepare a complete report of the geology of the region when he has completed the task of working out, in the field, the difficult and intricate relations of the rocks.

Another line of work has been on the lakes which are so abundant in Wisconsin. A hydrographic survey has been made of more than 60 of the more important lakes in the southeastern part of the State, and maps of these lakes have been published. The investigation of the biology of the waters has been fairly begun. The physica geography of the lake region of southern and eastern Wisconsin is now being studied by Mr. N. M. Fenneman.

The first educational bulletin has recently been published by Professor R. D. Salisbury, on the physical geography of the region about Devil's Lake. This is intended to set forth the geography and the surface geology of the region in such a way as to bring out the principles of physical geography involved, so that the book will be primarily of value to the teachers and students of the subject, but it is also a contribution to our knowledge of that region.

This brief notice touches only the most important directions in which the Survey has been working, leaving unmentioned many subjects to which less attention has been given.

So far as the experience of the Wisconsin Survey goes, it appears that the State is quite willing that a considerable amount of money should be devoted to investigations whose value is scientific in the fullest sense of the word, and it also expects a considerable amount of attention to be given to subjects of economic value and of immediate practical importance. This seems to me to be entirely right. The State has a right to expect an economic return for money expended in a State survey, especially as there are

subjects of economic value which demand immediate investigation and whose study is the duty of a survey. On the other hand, the Survey ought not to allow its attention to be directed to subjects of immediate economic interest only, since, as we all know, the pure science of the present becomes the applied science of the future, and it is eminently the task of the Survey to work for the future as well as for the present. The Wisconsin Survey has endeavored to fulfill both these requirements, so far as the means at its disposal would permit, and its efforts have been fully endorsed by the State.

E. A. BIRGE.

UNIVERSITY OF WISCONSIN.

THE Natural History Survey of Minnesota is being carried on in pursuance of an act approved in 1872, and entitled "An act to provide for a geological and natural history survey of the State and to entrust the same to the University of Minnesota." In accordance with this law the Board of Regents of the University at once appointed Professor N. H. Winchell geologist of the Survey and placed the work under his supervision. The funds for carrying on the work have been almost wholly derived from the sale of so-called 'State salt lands' set aside for the Survey. After about 20 years of good work by the geologist, the geological work has been ordered to be brought to a close and the natural history has been taken up, with the professors of botany and zoology in charge of the botany and zoology respectively.

The law creating this Survey is so broad in its scope that so-called purely scientific investigations are as incumbent upon those in charge of the work as the so-called economical. Accordingly we do not at present divide this work into scientific and economical problems, but try to do scientifically everything we undertake to do, whether it has an immediate practical bearing or not. Economical and practical questions are by no means neglected, and the plans at present being followed contemplate reports that will be of educational and scientific value, as well as a handy source of information to the citizens of the State.

On the zoological side the vertebrates are at present receiving the most attention. So far as possible complete accounts of certain more or less typical species, and species that for one reason or another are of special interest and importance, are being prepared in connection with the more general reports. These individual biographies, as they might be called, are intended to serve as guides and reference texts in the schools of the State. The invertebrates are not being neglected, though with the exception of one or two groups they are not receiving special attention at present. Plankton work can not be said to have received any serious consideration, and probably will not as long as more promising and less 'killing' fields are as plentiful as they are.

In reply to questions and suggestions, it was stated that both the botanist and zoologist made it a point to send their reports, not only to all the schools of the State, but so far as possible also to all the newspaper offices in the State.

An examination of Minnesota Plant Life, issued by the botanist of the survey, will convince the most skeptical that State reports can be issued in the best typographical style. This matter, however, demands special attention and experience.

In consequence of the close connection between the University and the Natural History Survey, the biological departments of the University have become the bureau of information on natural history questions for the entire State, and the professors of botany and zoology annually answer hundreds of letters—yes, in some years, thousands.

The matter of cooperation between the

surveys of the different States has come up frequently, but I am not sure that we are ready for any definite plans. It would seem that cooperation along some lines at least would lead to most valuable results, but how to adjust these so differently organized surveys is much more difficult than picking out the problems. I am inclined to believe that we shall have to go over our fields independently at first and look toward cooperation later on. In the meantime suggestions and discussions and reflection should not be set aside altogether.

H. F. Nachtrieb.
University of Minnesota.

It is to be regretted that Professor Forbes is necessarily absent from this meeting, since he only can adequately discuss matters connected with the Natural History Survey of the State of Illinois. It is to his energy and foresight that the Illinois State Laboratory of Natural History, which is charged with its accomplishment, owes its origin, some twenty-five years ago, and it is to his oversight and direction that its success is due.

The conditions affecting the biological survey of Illinois differ materially in several particulars from those existing in Minnesota and Wisconsin. Illinois has no State geologist nor State geological survey, so that from its beginning the biological survey has been free from some of the difficulties experienced in a few of the neighboring States.

In 1877 the Legislature established what is known as the Illinois State Historical Library and Natural History Museum, at Springfield, and the Illinois State Laboratory of Natural History, at Normal, Illinois, with Professor S. A. Forbes as its director. The State Laboratory was established with several functions to perform. The law provided that by it the museum at Springfield should be supplied with material illustrating the fauna of the State; that educational institutions and high schools should be supplied with material for instructional purposes; and besides these educational activities, a State survey of the animals and cryptogamic plants was to be carried on; and, finally, certain studies of an economic character were to be made with reference to the food of fishes and of birds. In 1883 the director was made State Entomologist, and for a number of years subsequently there was no sharp division between those operations of the State Laboratory carried on in connection with economic entomology and those for which the institution was originally established. In 1885 the State Laboratory was moved to Urbana in consequence of the appointment of its director to the chair of zoology in the University of Illinois. From 1883 to 1893 the Natural History Survey work was somewhat intermittent in character, but with the establishment of the Biological Station on the Illinois river, the work has been carried on continuously along the lines originally intended. The appropriations have in most cases been reasonably liberal, and have gradually increased from $3,000 per annum to nearly $10,000, aside from the appropriations for economic entomology. At no time has the State Laboratory had the backing of any scientific society or of any other association in any way helpful in securing legislative appropriations. It has at all times stood strictly on its merits and the value of the work accomplished, and its continual growth is due to the confidence which members of the Legislature have felt in the integrity of the director as a man, and in his energy and ability as a scientist.

The laws under which the State Laboratory was founded and has been supported seem to emphasize the educational part of its duties rather than the scientific and economic features. Professor Forbes's working definition of 'survey' involves more than a

mere census of animals and plants or a publication of lists showing local and geographical distribution. It is broad enough to include matters of an ecological character, and this view has largely determined the general plan of operations. It would have taken less time to send the material of the various collections to specialists at Washington, or elsewhere, and have identifications made by them, than to collect the necessary literature and allow the time and expense involved in the training of a group of specialists on the staff of the State Laboratory; but the former plan would have resulted simply in the accumulation of named material as a basis for lists of plants and animals with reference to local and geographical distribution, while the latter course is essential to a natural history survey in a wider sense. The director regards as one of the most important objects to be attained by the State Laboratory investigations, the presentation of the knowledge obtained in a form accessible to all interested intelligent citizens of the State. Much remains to be done before this work will be completed. Most of the literature thus far published by the State Laboratory has been more or less technical and written with reference to the specialist, but such material is to be considered as a sort of by-product incidental to the prosecution of the more essential duties.

Two important lines of work are now in progress. One of these, the ichthyological survey, has received much attention during the past two years and will result in the publication of a comprehensive report on all the fishes occurring within the borders of the State, in which as full an account as practicable of life histories, habits and conditions of environment will be given in addition to the ordinary descriptive matter. Each species is to be illustrated by colored plates made from living specimens. I have brought, for the inspection of those interested, a few of the drawings already prepared, which reflect great credit on the State Laboratory artist, Miss Lydia M. Hart, by whom they were made.

Another line of work which is being vigorously prosecuted is the study by Dr. Kofoid of the plankton material collected from the Illinois river at frequent intervals during a period of nearly five years. The work of counting has been completed, and the data are being got into proper form as rapidly as possible. As a result of this work much interesting and important knowledge is being gained concerning the life histories, seasonal distribution, relative numbers and sequence of succession of many of the minute organisms composing the river plankton. As most of the counting work has been done since Dr. Kofoid made a preliminary report in this place a year ago, I may mention that some interesting facts stated by him in a tentative way have been confirmed. For example: (1) the marked constancy in the seasonal recurrence of many species, with their maximum and minimum numbers appearing annually within narrow time limits—perhaps an adaptation to definite temperature conditions; (2) the constancy of a spring and fall maximum for many species, the latter secondary—these maxima indicating perhaps an adaptation to the mean temperature of the year; (3) the evidence of the extreme variability of some of the limnetic forms and the probable genetic connection within the season of a number of supposed species—as in the case of *Brachionus bakeri* and its related forms and of *Dinobryon*, composite colonies of the latter being often found, different portions of which are made up of very different types of individuals, types which more frequently will be found in small colonies of homogeneous character and which have received various specific names; (4) the presence of a minute plankton flora occurring within about the same seasonal limits

as the foliage of the trees and disappearing as abruptly. For the greater part these forms are so minute that they ordinarily escape the silk net, and it is only in collections made by some filter method that an adequate idea of their importance can be gained. Detailed examination of the filter-paper catches tends to confirm the criticisms of Dr. Kofoid with reference to the dependence on collections made by the silk net alone. The loss by leakage or escape is often volumetrically as well as numerically very large. Other interesting facts might be referred to, but there is scarcely sufficient excuse for it in this connection.

A paper of systematic character on the leeches of the State Laboratory collection, by Mr. J. Percy Moore, is now in press, and an article on the Odonata, by Professor Needham and Mr. Hart, is nearly ready for the printer. Aside from numerous publications of an economic entomological character there have been published two quarto volumes on the birds of the State, and five volumes of the *Bulletin of the Illinois State Laboratory of Natural History.*

As to future work, it is probable that a comprehensive entomological survey entirely distinct from economic investigations will be undertaken in the near future, and work is now in progress on the first one of a special series of bulletins of what may be termed an educational nature, in which the object will be to treat various groups of animals in such a way as best to meet the needs especially of teachers and students of zoology in high schools and colleges. These bulletins, while giving descriptions and synoptic keys, are at the same time to include such physiological and ecological matter as will make them useful. It is intended that they shall be scientific, but written for others than specialists.

While cooperation in the work of the various State surveys would theoretically have several advantages, it practically seems well-nigh unattainable because of the great difference in the conditions governing the action of each. Efforts have been made within the past few years to bring about such cooperation, but without result. If it were possible to have the energies of different surveys directed in part along similar lines of work synchronously, so that one specialist might work up a given group of animals for several States, there would be evident economy in time and money; or such special educational publications as those previously referred to might, with comparatively small additional outlay of time and money, be adapted to use in several States instead of but one. It might be greatly to the advantage of the surveys in different States if competent men in charge of the biological departments of some of the educational institutions of the State should become interested and responsible for the working up of special groups; and as far as Illinois is concerned, Professor Forbes would be greatly pleased if such cooperation between the State Laboratory and some of the working biologists in the State might be accomplished. He would willingly procure necessary literature and aid in the matter of collections, and although not ready to make unconditional promises of compensation, would, I am sure, feel warranted in cooperation of a financial, as well as of a scientific, sort. Here we meet with one of the great difficulties in the economical prosecution of such survey work. The instruction in our leading institutions is so exclusively along morphological and physiological lines that the men coming from such institutions are not prepared for the kind of work required in surveys, and much time and expense is involved before they can accomplish results. A vacancy on the State Laboratory staff is often a serious matter, because of the impossibility of finding men already prepared to prosecute such work.

Frank Smith.
University of Illinois.